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Geng, Bo; Yoshida, Ken; Jensen, Winnie

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# PSYCHOPHYSICAL EVALUATION OF THE EFFECT OF ELECTRODE LOCATION ON SENSATIONS DURING ELECTROCUTANEOUS STIMULATION

Geng B<sup>1</sup>, Yoshida K<sup>1,2</sup>, Jensen W<sup>1</sup>

<sup>1</sup> Aalborg University, Aalborg, Denmark

<sup>2</sup> Indiana University-Purdue University Indianapolis, Indianapolis, U.S.A.

E-mail: [bogeng@hst.aau.dk](mailto:bogeng@hst.aau.dk), [yoshidak@iupui.edu](mailto:yoshidak@iupui.edu), [wj@hst.aau.dk](mailto:wj@hst.aau.dk)

**AIM:** Electrical stimulation can potentially be used to create sensations for use as feedback in advanced prosthetics. This study aims to evaluate the psychophysical effect of electrode location on sensations during electrocutaneous stimulation.

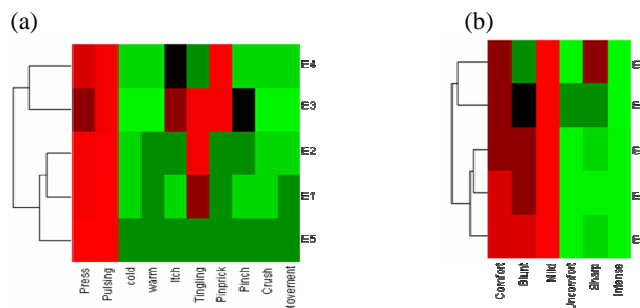
**METHODS:** 16 healthy subjects were included in the study (Aged 22-36). Five electrodes were placed around the left forearm 5 cm distant to the antecubital crease, as follows: 1) Electrode 1 (E1) over the median nerve, 2) Electrode 2 (E2) laterally adjacent to E1, 3) Electrode 3 (E3), 4 (E4), and 5 (E5) equally spaced between E2 and E1. Fixed-amplitude biphasic square pulse stimuli at three times of sensory threshold were applied through the five electrodes. Immediately following each stimulus, subjects were presented a questionnaire to score the perceived sensation types and quality. A visual analog scale (VAS) was used to measure the sensation strength.

**RESULTS:** All the 16 subjects reported tactile sensations (press or pulsing) at the E1 site, while fewer subjects reported tactile sensations at the E3 or the E4 site. The lowest sensation strength reported by the subjects appeared at site E4. Table 1 describes the responses of tactile sensation in detail. Based on the Friedman test, the five electrode sites show statistically significant differences in the perceived strength of tactile sensation ( $p=0.003$ ). Moreover, clustering of sensation types indicated that E3 and E4 tend to evoke similar sensation types, while E1, E2 and E5 fall into another cluster (figure 1 (a)). Clustering of sensation quality gives the same cluster result (figure 1(b)).

**CONCLUSION:** Electrical stimulation to the different sides of the forearm evoked different responses. Stimulation of the ventral side was more likely to induce tactile sensations. Moreover, the magnitude of the perceived sensations was stronger on the ventral side compared to the dorsal side at the same level of stimulation. It seems to be more appropriate to induce sensation feedback on the ventral than the dorsal side of the forearm.

**Table 1:** The number of subjects who reported ‘tactile’ sensation, the mean of the tactile sensation strength (VAS) at the five electrode sites.

| Electrode site     | E1   | E2   | E3   | E4   | E5   |
|--------------------|------|------|------|------|------|
| Number of subjects | 16   | 13   | 8    | 9    | 14   |
| Mean of VAS        | 2.54 | 2.95 | 2.80 | 1.63 | 2.10 |



**Figure 1:** Clustering of the five electrode sites (16 subjects): (a) Sensation type. (b) Sensation quality.